

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Canceled)

Claim 2 (currently amended): ~~The method of claim 1, wherein:~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;

identifying each of the plurality of seedlings in the captured digital image;

determining a primary path of each of the plurality of seedlings;

determining at least one value from the primary path of each of the plurality of seedlings
~~comprises the step of including~~ determining a value corresponding to an overall
length of each of the plurality of seedlings from the primary path of each of the
plurality of seedlings; and

determining a seed vigor index from at least the values determined from the primary path
of each of the plurality of seedlings ~~includes~~ including determining a seed vigor
index from at least the value corresponding to the overall length of each of the
plurality of seedlings.

Claim 3 (Canceled):

Claim 4 (currently amended): ~~The method of claim 1 further comprising~~ A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;

identifying each of the plurality of seedlings in the captured digital image;

determining a primary path of each of the plurality of seedlings;

determining a separation point between the hypocotyl and the radicle of each of the plurality of seedlings; and:

~~wherein~~ determining at least one value from the primary path of each of the plurality of seedlings ~~comprises~~ including determining a hypocotyl length value corresponding to the length of the hypocotyl of each of the plurality of seedlings and a radicle length value corresponding to the length of the radicle of each of the plurality of seedlings; and

~~wherein~~ determining a seed vigor index from at least the values determined from the primary path of each of the plurality of seedlings ~~comprises~~ including determining a seed vigor index from at least the hypocotyl length value and the radicle length value.

Claims 5-6 (Canceled)

Claim 7 (currently amended): ~~The method of claim 1 wherein~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;

identifying each of the plurality of seedlings in the captured digital image;

determining a primary path of each of the plurality of seedlings comprises including

determining for each of the plurality of seedlings a locus of pixels, the locus of pixels corresponding to the primary path of the respective seedling and the locus of pixels being one pixel in width;

determining at least one value from the primary path of each of the plurality of seedlings;

and

determining a seed vigor index from at least the values determined from the primary path of each of the plurality of seedlings.

Claim 8 (currently amended): ~~The method of claim 1 further comprising~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;

identifying each of the plurality of seedlings in the captured digital image;
separately identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings, ~~and;~~
~~wherein~~ determining a primary path of the at least one seedling ~~comprises~~ including determining a primary path for each of the separately identified overlapped seedlings;
~~wherein~~ determining at least one value from the primary path of the at least one seedling ~~comprises~~ including determining from the primary path for each of the separately identified overlapped seedlings a length value corresponding to an overall length of that separately identified overlapped seedling; and
~~wherein~~ determining a seed vigor index from at least the values determined from the primary path of the at least one seedling ~~comprises~~ including determining a seed vigor index from at least the length values.

Claim 9 (currently amended): ~~The method of claim 1 further comprising~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;
identifying each of the plurality of seedlings in the captured digital image;
separately identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings, ~~and;~~
~~wherein~~ determining a primary path of the at least one seedling ~~comprises~~ including determining a primary path for each of the separately identified overlapped seedlings;
~~wherein~~ determining at least one value from the primary path of the at least one seedling ~~comprises~~ including determining from the primary path for each of the separately identified overlapped seedlings a length value corresponding to the length of at least one of the hypocotyl of that separately identified overlapped seedling and the radicle of that separately identified overlapped seedling; and

~~wherein~~ determining a seed vigor index from at least the values determined from the primary path of the at least one seedling ~~comprises~~ including the step of determining a seed vigor index from at least the length values.

Claim 10 (currently amended): ~~The method of claim 1 further comprising~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;

identifying each of the plurality of seedlings in the captured digital image;

separately identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings; ~~and;~~

~~wherein~~ determining a primary path of the at least one seedling ~~comprises~~ including determining a primary path for each of the separately identified overlapped seedlings;

~~wherein~~ determining at least one value from the primary path of the at least one seedling ~~comprises~~ including determining from the primary path for each of the separately identified overlapped seedlings a hypocotyl length value corresponding to the length of the hypocotyl of that separately identified overlapped seedling and a radicle length value corresponding to the length of the radicle of that separately identified overlapped seedling; and

~~wherein~~ determining a seed vigor index from at least the values determined from the primary path of each of the plurality of seedlings ~~comprises~~ including determining a seed vigor index from at least the plurality of hypocotyl length values and at least the plurality of radicle length values.

Claim 11 (previously presented): The method of claim 8 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 12 (previously presented): The method of claim 9 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 13 (previously presented): The method of claim 10 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 14 (previously presented): The method of claim 8 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 15 (previously presented): The method of claim 9 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 16 (previously presented): The method of claim 10 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 17 (previously presented): The method of claim 8 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 18 (previously presented): The method of claim 9 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises

evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 19 (previously presented): The method of claim 10 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 20 (previously presented): The method of claim 8 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 21 (previously presented): The method of claim 9 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 22 (previously presented): The method of claim 10 wherein separately identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 23 (currently amended): ~~The method of claim 1 further comprising:~~ A method for automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;
identifying each of the plurality of seedlings in the captured digital image;
determining a primary path of each of the plurality of seedlings;
determining at least one value from the primary path of each of the plurality of seedlings;
determining a seed vigor index from at least the values determined from the primary path
of each of the plurality of seedlings;
determining a first locus of points indicating the hypocotyl of at least one seedling;
determining a second locus of points indicating the radicle of the at least one seedling;
overlaying the first and second loci over an image of the seedlings to generate a
composite image; and
displaying the composite image.

Claim 24 (previously presented): The method of claim 23 wherein displaying the composite image comprises displaying the composite image on a video display terminal.

Claim 25 (previously presented): The method of claim 23 wherein displaying the composite image comprises printing the image on a printer or plotter.

Claims 26-39 (canceled)

Claim 31 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;
identifying each of the plurality of seedlings in the captured digital image;
determining a primary path of each of the plurality of seedlings;
determining a separation point between the hypocotyl and the radicle of each of the
plurality of seedlings;

determining a hypocotyl length value corresponding to the length of the hypocotyl of each of the plurality of seedlings and a radicle length value corresponding to the length of the radicle of each of the plurality of seedlings; and
determining a seed vigor index from at least the hypocotyl length value and the radicle length value.

Claim 32 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;
identifying each of the plurality of seedlings in the captured digital image;
determining a primary path of each of the plurality of seedlings including determining for each of the plurality of seedlings a locus of pixels, the locus of pixels corresponding to the primary path of the respective seedling and the locus of pixels being one pixel in width.;
determining at least one value from the primary path of each of the plurality of seedlings;
and
determining a seed vigor index from at least the values determined from the primary path of each of the plurality of seedlings.

Claim 33 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

capturing a digital image of each of the plurality of seedlings;
identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings, and:
determining a primary path of each of the overlapped seedlings
determining from the primary path for each of the overlapped seedlings a length value corresponding to an overall length of that overlapped seedling; and
determining a seed vigor index from at least the length values of each of the overlapped seedlings.

Claim 34 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

- capturing a digital image of each of the plurality of seedlings;
- identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings, and:
- determining a primary path of each of the overlapped seedlings
- determining from the primary path for each of the overlapped seedlings a length value corresponding to the length of at least one of the hypocotyl of that separately identified overlapped seedling and the radicle of that separately identified overlapped seedling; and
- determining a seed vigor index from at least the length values of each of the overlapped seedlings.

Claim 35 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

- capturing a digital image of each of the plurality of seedlings;
- identifying a plurality of overlapped seedlings in the digital image of at least one of the plurality of seedlings, and:
- determining a primary path of each of the overlapped seedlings
- determining from the primary path for each of the overlapped seedlings a hypocotyl length value corresponding to the length of the hypocotyl of that overlapped seedling and a radicle length value corresponding to the length of the radicle of that overlapped seedling; and
- determining a seed vigor index from at least the plurality of hypocotyl length values and at least the plurality of radicle length values.

Claim 36 (previously presented): The method of claim 33 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 37 (previously presented): The method of claim 34 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 38 (previously presented): The method of claim 35 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function.

Claim 39 (previously presented): The method of claim 33 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 40 (previously presented): The method of claim 34 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 41 (previously presented): The method of claim 35 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings.

Claim 42 (previously presented): The method of claim 33 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 43 (previously presented): The method of claim 34 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy

function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 44 (previously presented): The method of claim 35 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths do not make unnaturally sharp turns and seedling edges should be used as much as possible.

Claim 45 (previously presented): The method of claim 33 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 46 (previously presented): The method of claim 34 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 47 (previously presented): The method of claim 35 wherein identifying a plurality of overlapped seedlings in the digital image of at least one seedling comprises evaluating an energy function based on proposed configurations of at least partial primary paths of overlapped seedlings using the following heuristics: primary paths should not make unnaturally sharp turns, seedling edges should be used as much as possible, and all primary axes should have a separation point between the hypocotyl and the radicle.

Claim 48 (previously presented): A method of automatically analyzing a plurality of seedlings germinated from a plurality of seeds, comprising:

- capturing a digital image of each of the plurality of seedlings;
- identifying each of the plurality of seedlings in the captured digital image;
- determining a primary path of each of the plurality of seedlings;
- determining at least one value from the primary path of each of the plurality of seedlings;
- determining a seed vigor index from at least the values determined from the primary path of each of the plurality of seedlings;
- determining a first locus of points indicating the hypocotyl of at least one seedling;
- determining a second locus of points indicating the radicle of the at least one seedling;
- overlaying the first and second loci over an image of the seedlings to generate a composite image; and
- displaying the composite image

Claim 49 (previously presented): The method of claim 48 wherein displaying the composite image comprises displaying the composite image on a video display terminal.

Claim 50 (previously presented): The method of claim 48 wherein displaying the composite image comprises printing the image on a printer or plotter.

Claim 51 (Canceled)